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Why do platform leaders acquire? A multiple case study of Google, Apple, Facebook, and Amazon

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Abstract

Platform leaders like Google, Apple, Facebook, and Amazon are some of the world's most valuable companies today. They have proven the effectiveness of a Multi-Sided Platform (MSP) business model, and are examples of successful platforms. However, the role of acquisitions for their success has remained an elusive topic in research. These companies are both technology and platform companies, but the interplay of these two is yet not well understood. This thesis integrates the acquisition, platform strategy, and software stack literatures to study the acquisitions of platform leaders.

This thesis finds strong evidence that middleware technology is strategic for platform leaders in fighting platform wars. Additionally, this thesis demonstrates two distinct phases of acquisition behavior: focused platform development and platform wars. In the first phase, platform leaders utilize a coring strategy to focus on mostly buying highly similar technological assets. In the second phase, platform leaders utilize acquisitions to support their tipping strategy, while simultaneously preventing competitors from gaining access to world-class middleware technology talent that could enable hostile platform envelopment attacks. More specifically, platform leaders compete of middleware technologies that enable superior user interfaces, as well as middleware technologies that speed up their ecosystem's innovation speed.

For academia, this thesis further validates the viability of the software stack as a model to analyze technology companies, and builds on platform strategy literature to demonstrate how acquisitions contribute to implementing platform strategies. By describing the acquisition activity of the world's leading platform companies, this thesis supports managers in their effort to create strategies for developing new and existing platforms. However, more research, looking at acquisitions from inside platform companies, needs to be conducted to further validate and generalize these results.

Keywords multi-sided platforms, platform leaders, platform strategy, technology acquisitions, stack, software stack

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Johtavat alustayritykset kuten Google, Apple, Facebook ja Amazon lukeutuvat tällä hetkellä maailman arvokkaimpiin yrityksiin. Nämä yritykset ovat osoittaneet monisuuntaisten alustojen tehon liiketoimintamallina, ja ovatkin esimerkkejä menestyneistä alustoista. Yritysostojen rooli alustojen menestyksessä on kuitenkin jäänyt tutkimuksessa vähälle huomiolle. Johtavat alustayritykset ovat myös teknologiayrityksiä, ja tämä diplomityö tutkii yrityskauppojen merkitystä alustayrityksille yhdistäen kirjallisuutta yrityskauppojen, alustojen ja ohjelmistopinojen tutkimusaloilta.

Löydän diplomityössäni vahvoja todisteita siitä, että väliohjelmisto on strategista teknologiaa johtaville alustayrityksille silloin, kun ne käyvät alustasotia kilpailijoitaan vastaan. Näytän diplomityössäni myös kaksi yrityskauppatoiminnan vaihetta, joista ensimmäisessä johtavat alustayritykset ostavat alustansa kanssa samankaltaisia teknologisia resursseja tukeakseen keskiöstrategiaansa. Toisessa vaiheessa johtavat alustayritykset käyttävät yritysostoja tukeakseen keikautusstragiaa, jossa ne samanaikaisesti mahdollistavat pyrkimyksiään sulauttaa kilpailijoiden alustojen toiminnollisuuksia omaan alustaansa, ja estävät kilpailijoita tekemästä samaa viemällä markkinoilta pois tarvittavaa osaamista. Tässä toisessa vaiheessa johtavat alustayritykset ostavat väliohjelmistoteknologioita, jotka mahdollistavat parempien käyttöliittymien kehityksen, sekä muita väliohjelmistoteknologioita, jotka tukevat ostajan ekosysteemin innovointinopeuden kasvattamista.

Diplomityöni vahvistaa käsitystä teknologiapinon käyttökelpoisuudesta teknologiayritysten analysoinnissa ja tukee alustastrategiakirjallisuutta näyttämällä, miten yritysostoja voidaan käyttää alustastrategioiden osana. Kuvaamalla maailman johtavien alustayritysten yrityskauppatoimintaa työni tukee myös yritysjohtajia heidän pyrkimyksissään luoda uusia, sekä kehittää olemassa olevia alustoja. Tämän työn tuloksien vahvistaminen vaatii kuitenkin tutkimuksia, joissa yrityskauppatoimintaa katsotaan erityisesti myös yritysten sisältä.

Avainsanat monisuuntaiset alustat, johtavat alustayritykset, alustastrategia, teknologiayritysostot, pino, ohjelmistopino

Preface

I am grateful for the possibility to work on such an interesting topic. Firstly, thank you Professor Robin Gustafsson for your continuous support throughout the thesis. The inspiration for the topic, the numerous guiding sessions to help clarify the focus of the thesis, and your trust in my work were of paramount importance in writing this thesis. Our problem-solving sessions were, without a doubt, among the most inspiring steps in writing this thesis. Secondly, thank you D.Sc. (Tech.) Kimmo Karhu for inspiring this interesting topic, and for lending me your deep understanding of software stacks to help me understand the dynamics of the model. The foundation of this thesis is built on your expertise.

I also want to thank my family for their continuous support throughout the process. S and H, thank you for always showing me your support, and for the exchange of ideas. Thank you, S, for the cheerful messages to keep the spirit up. J, your support has been incredible throughout the thesis. You were always there for me to exchange ideas and take them to another level, believed in me every step of the process, and helped me take the extra steps needed to write a thesis I can be proud of. Thank you.

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Abbreviations

AS	Application Software
MW	Middleware Services
SS	System Software
HW	Hardware
MSP	Multi-Sided Platform
M&A	Mergers and Acquisitions
FY	Financial Year
CAGR	Compound Average Growth Rate
GAFA	Google, Apple, Facebook, and Amazon
IS	Information System
IT	Information Technology
SW	Software
NLP	Natural Language Processing
InfSec	Information Security

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1 Introduction

Multi-sided platforms (MSPs) are among the most powerful and valuable business models of today. Hagiu (2014) defines MSPs as "technologies, products or services that create value primarily by enabling direct interactions between two or more customer or participant groups". The success of such business models is illustrated by technology-based MSP companies like Google, Apple, Facebook, and Amazon, often together referred to as GAFA, that are among the most valuable companies in the world. These companies can be considered "platform leaders", who Gawer and Cusumano (2002) define as "companies that drive industry wide innovation for an evolving system of separately developed pieces of technology". These companies have different roots: Google's in internet Search, Apple's in computer system development, Facebook's in social media, and Amazon's in online book retail. However, today these companies are facing each other increasingly as competitors in industries that appear to be away from their roots, in fields such as mobile phone operating systems, advertising, self-driving cars, entertainment, and many others. In an increasingly digital environment, understanding the strategies these companies employ helps companies across industries to better capitalize on their own platform initiatives. The role of acquisitions for platforms is an essential yet under-researched topic, and the current research from mergers and acquisitions (M&A), platform, or information system (IS) fields do not properly explain the platform leaders' M&A activity. Thus, this thesis seeks to answer the research question:

Why do platform leaders acquire?

Platform leaders' acquisitions follow a different set of rationales than traditional M&A rationales. While M&A deals come in different types, the platform leaders like GAFA focus almost exclusively on technology acquisitions: the acquisition of companies with technological assets. This focus on technology M&A is no surprise, as MSPs are dependent on the digital technology that powers their interactions and network effects. To simplify, technology acquisitions can be justified either by gaining access to the target's business, or by gaining access to target's technological assets and capabilities, or both. In the case of business benefits, a platform company might acquire a target to bring in users to its own platform.

When technology companies acquire technological resources, the acquisitions often follow a *build or buy* -decision, where the acquiring company evaluates whether they have the time, skills, and resources to build a needed technology themselves, or if they need to acquire the technology. Cohen (2012) supports this unique rationale in technology acquisitions, arguing that the unique needs such as tapping into innovative potential of young, entrepreneurial firms, obtaining engineering capabilities, keeping key employees of the acquired company, and quick integration of acquired technology into acquirer's core business make technology M&A unique from other sectors. Scholars have also suggested that firms utilize acquisitions as a means of innovation (Puranam and Srikanth, 2007), achieving strategic renewal (Agarwal and Helfat, 2009), and to acquire scarce resources held by internet firms (Uhlenbruck, Hitt and Semadeni, 2006). In this context, acquirers benefit from the ability to integrate new technologies quickly. Benitez-Amando and Ray (2012) suggest IT integration capability and flexible IT infrastructure enable companies to pursue M&A opportunities and help them realize the economic benefits, which partially explains large technology companies' high M&A activity.

While technology acquisitions can be utilized to access new technologies, they have also become a recruiting tool. Most successful technology companies have begun to utilize a novel tool of acqui-hiring, the practice of acquiring relatively small companies for their talent, to satisfy their demand for engineering talent and capabilities (Coyle and Polsky, 2013). While access to talent is seen as an important driver of these acquisitions, Sawicki (2015) also highlights access to patents as an additional benefit of this approach over simply hiring a start-up's engineers. Sometimes, rare world-class digital talent can lie only in small, yet successful ventures, making the incentives of traditional recruiting less compelling if the key talent has equity in the venture. Facebook, for example, acquired a Malaysian two-person company Octazen Solutions in 2010 to gain access to some of the world's best talent in the field of web scraping (Arrington, 2010). However, the current research has not yet focused on creating a model that would explain what specifically drives such costly measures when the acquirers are platform leaders.

Platform companies utilize different acquisition strategies at different stages of their development. One of the determinants of acquisition strategy is organizational slack, excess resources available for use. A higher amount of organizational slack increases experimentation activity, which can result in identifying and pursuing new opportunities (Levinthal & March, 1981). This slack is often higher for more developed companies, suggesting a more active and varying acquisition activity for more developed platform companies.

General platform strategies also vary for platforms at different stages of development. To initially create a platform, Gawer and Cusumano (2008) suggest a coring strategy. The strategy includes four possible technology-related actions: solving an essential system problem, facilitating provision of add-ons by external companies, keeping intellectual property of your technology closed, and maintaining strong interdependencies between the platform and its complements. In this strategy, the focus for the platform company is to develop “unique, compelling features that are hard to imitate and that attract users” (Gawer and Cusumano, 2008). While platform companies might want to speed up this process by utilizing technology acquisitions, many successful platform companies started entrepreneurially and would be hindered in such efforts by the lack of excess resources. However, the current research has not explored what kinds of acquisitions could be important enough for platform companies to make at this stage.

For fighting platform wars at later stages of platform development, Gawer and Cusumano (2008) suggest a tipping strategy, also commonly known as “platform envelopment” (Eisenmann, Parker and Van Alstyne, 2011). In this strategy, the technology-related actions for the platform company are to “absorb and bundle technical features from an adjacent market” (Gawer and Cusumano, 2008). In contrast to the focused development in an early stage platform coring strategy, the focus shifts into a more competitive one. At this stage, the platform company would typically have gained some success and would thus be more likely to have organizational slack to enable technology acquisitions. Furthermore, such acquisitions could help platform companies in their platform envelopment efforts. However, the viability of a platform business model is dependent on the platform's ability to produce network effects. Compared to a conventional supplier-buyer perspective where increased competition can be observed as a reduction in market share, a platform's market share might vanish completely if a hostile platform envelopment attack manages to draw enough participants from the platform to drastically reduce its network effects. In this environment, a technology acquisition by a competitor could prompt an extensive competitive response, as the acquired technologies could enable a hostile platform envelopment attack. Regardless, the current research has yet not explored how platform leaders utilize acquisitions in support of and in defense to a platform envelopment strategy.

Scholars have long argued that complementarity is an important feature of successful M&A. Bauer and Matzler (2014) find evidence for the decisive role of strategic complementarity for post-merger integration and overall M&A success, and Grill and Bresser (2013) suggest that acquisitions benefit the acquirer when both the acquirer and target possess strategically valuable capabilities. Hildebrand et al. (2015) also find that car original equipment manufacturers (OEMs) who acquire complementary and heterogeneous external knowledge on digital technologies and possess the ability to integrate and commercialize the knowledge, are better prepared to digitally transform their business. Additionally, Wang and Zajac (2007) find that companies favor acquisitions over alliances more often when their resources are similar. Utilizing the software stack model and the distance between layers as a measure of complementarity, Gao and Iyer (2006) also find a link between superior M&A performance and technological complementarity between the acquirer and target. While complementarity has been found to positively impact M&A, there is still clear demand for conceptual work on the construct of complementarity (Bauer and Matzler, 2014).

The existing M&A research has not addressed how value is created by acquirers who are operating in digital industries and organized in value networks, or how the acquired technology is related to the acquirer's technology (Toppenberg, Henningsson and Eaton, 2016). Toppenberg, Henningsson and Eaton (2016) address this gap in their study about the technology acquisitions made by Cisco, finding that they used 'coring acquisitions' to buy technologies that could give the primarily hardware-focused company a head-start on competition to create a more software driven ecosystem. However, their study focuses on the technology acquisitions that help to create an ecosystem, rather than on how to use them to compete when an ecosystem or platform already exists. The study also identifies complementarity between hardware and software, but does not explicate between different kinds of software. Furthermore, Cisco is an established company, while many platforms are created by entrepreneurial companies with scarce resources. Thus, the current research still lacks in explaining what types of technologies are complementary to platform companies and why, how entrepreneurial platform companies use technology acquisitions in support of their coring strategy, and how technology acquisitions are used during platform wars.

While making acquisitions can help companies build their technological capabilities, other platform literature provides a lens to understand how these capabilities, often referred to as information system capabilities, can benefit the development of platforms and give them competitive advantage. Tan et al. (2015) suggest that IS capabilities have an evolutionary nature in MSP development, and propose that different information system capabilities are crucial in different stages of MSP development. Leaning on the Resource-Based-View, Wade and Hulland (2004) find potential for sustained competitive advantage in hard to transfer information system technical skills, information system development capabilities like managing a system's development life-cycle, and cost effective information system operations. However, Koch and Windsberger (2017) argue that traditional strategic models of competitive advantage like Resource-Based-View, industry structure view, or dynamic capabilities approach, are built on assumptions that are no longer valid in today’s digital environments. Industries are no longer relatively stable but rather turbulent, planning has become more challenging and is replaced with ability to adapt to changes, and value creation has shifted from products made by individual companies to collaborative networks, such as platforms. Thus, it is highly relevant to take a more network-based approach to understand acquisition rationales of platform companies.

To cope with these changes, drawing on network theory, Koch and Windsberger (2017) suggest that an inter-organizational network structure, where resources and capabilities extend beyond firm boundaries, is the primary source of competitive advantage in an environment where industry boundaries are dissolving and digital technologies are a focal point of value creation. They further suggest that acquisitions are made to support the inter-organizational network structure of a company’s business, which is essentially how MSPs operate, but they recognize that their model lacks the granularity to explain which specific interactions or technologies of a platform are key to building competitive advantage in the digital economy.

The software stack model provides a structure to understand how the technological assets held by platform companies are intertwined, as well as how they relate to the technologies these companies acquire. Information technology companies like IBM have long approached the issue of technological relatedness with a layered architecture called the stack or the software stack (Gerstner, 2003; Gao and Iyer, 2006). This thesis seeks to integrate the technology M&A, platform, and information systems research with a software stack model. The integrated view is then tested with a group of competing platform leaders, the GAFA companies.

2 Theory

2.1 Technology framework

The abundance and interdependency of digital technologies have created a need for structuring and modeling them. As this thesis deals with technology acquisitions of platform companies, it needs to utilize a theoretical model to both categorize the different technologies and to understand how they relate to each other and the platform core. Somewhat similarly to this thesis, Toppenberg, Henningsson and Eaton (2016) study a platform leader Cisco's use of acquisitions in its shift from a hardware-based platform core to a software-based one. However, they do not utilize a clear model to structure the nature of its acquisitions complementarity to its platform core. As there is a large variety of different kinds of software, a simple division of technologies to software and hardware is too generic. For example, grouping Google's Android and Facebook's social media website under one software category would hide essential information about the nature of the software, how it contributes to a platform, and what kind of strategies it can enable. To identify patterns in acquisition behavior of multiple platforms and study how their platform core affects the acquisitions they make, the differences and similarities between technologies need to be more granularly structured.

Information technology companies like IBM have long approached this issue with a layered architecture called *the stack* or *the software stack* (Gerstner, 2003; Gao and Iyer, 2006). The stack model expands the software category into multiple different subcategories, and provides a perspective to how software in these categories relate to and operate with each other and with hardware. Essentially this layered architecture allows similar digital technologies to be grouped into layers that can interact with other layers based on a set of rules.

2.2 Software stack perspective to acquisitions on platforms

Based on the work by Gao & Iyer (2006) on measuring M&A complementarities with a software stack model, this thesis utilizes a similar layered model seen in Figure 1 to categorize technology companies into technology layers. The stack model serves as a framework for understanding digital technology components and their interplay, but also to understand how these different technologies can be used to conduct business.

Layering enables the analysis of interdependencies between different units of software, and Gao and Iyer (2006) found evidence that the distance between layers in the stack model can be used as a valid measure of complementarity. In general, technologies in the same layer are most similar, and the similarity decreases as the distance between layers grows (Gao and Iyer, 2006). Bachmann et al. (2000) define layering as dividing software into units where each unit represents a layer. Each layer represents a virtual machine that is “a collection of software that together provides a cohesive set of services that other software can utilize without knowing how those services are implemented” (Bachmann *et al.*, 2000). Bachmann et al. (2000) also note that virtual machines are only allowed to use the services of layers below it, either one layer or more apart depending on the utilized layering scheme. This thesis utilizes a layering scheme illustrated in Figure 1, where each technological component belongs to a layer, and can vertically only utilize services of other components one layer below itself, and horizontally also services from other components in the same layer. Application Software (AS) layer is the only exception in the horizontal interaction rule, as it only provides services to users rather than other technology components.

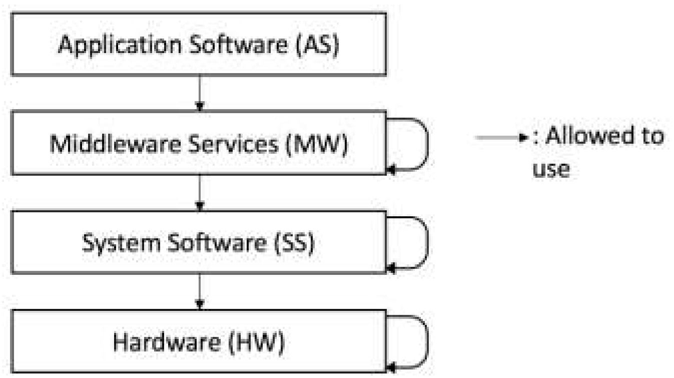

Figure 1 The software stack used in this thesis

The four layers shown in Figure 1 are defined as follows:

- **Application Software (AS)**: The highest layer of the stack. Includes end-user facing software with a user interface, and directly uses Middleware Services (MW) to operate. It provides, or can provide, its services to multiple end users, but not to other AS components.
- **Middleware Services (MW)**: The layer connecting AS and System Software (SS). Includes software components that can be used as services providing for multiple AS or other MW components. MW components utilize services from SS to handle operating with Hardware (HW), but does not directly connect to HW. Middleware is "reusable software that leverages patterns and frameworks to bridge the gap between functional requirements of applications and the underlying operating systems, network protocol stacks, and databases" (Schmidt and Buschmann, 2003).
- **System Software (SS)**: Technology components that abstract the use of Hardware (HW) to provide an interface for further software development. System Software (SS) can be utilized by multiple MW or some other SS, but cannot be used directly by AS. Such components include, for example, kernel, operating systems, databases and other large scale storage, cloud, and codecs. SS components provide libraries used by other SS or MW components, and are often directly compiled into machine language.
- **Hardware (HW)***:* Physical hardware components, such as memory, CPUs, and other semiconductors. Hardware components can provide services to multiple different SS components, but not to MW components directly. HW components connect to other HW as well, and the layer also includes the interoperability of HW components, the design of hardware systems, and their positioning to a physical chassis.

Digital offerings are built of separate technological units that, when connected, form software stacks that produce a set of services for users. These technological units are digitally operating assets, software or hardware, that require specific technical capabilities to be created. Each technological component belongs to one of the stack layers, and each layer holds multiple similarly operating technological components. Thus, every digital component in the Application Software (AS) layer requires the utilization of technological components in each of the lower layers. However, most companies only specialize in one or few layers of the stack and rely on third parties to provide the technology for the rest of the layers (Gerstner, 2003). Generally, a fully outsourced stack is easier to imitate as the used technology is available to anyone, and a fully in-house software stack is harder to imitate as third parties might not offer suitable substitutes for the used in-house technologies.

MSPs can also be seen to have their platform core, their own components, in specific layers of the stack. Like Cisco had their ecosystem core initially in hardware (Toppenberg, Henningsson and Eaton, 2016), in the software stack model platform companies can be seen to have their platform core in AS, MW, SS, or HW layers. Other companies with technology components in these same core layers are then more related to the MSP's technology, and through complementarity they would also be generally more valuable as technology acquisition targets than companies with technology in other stack layers.

Unlike some generally used stacks (Gerstner, 2003; Gao and Iyer, 2006), this thesis uses a stack that leaves out a services layer due to two key conflicts. Firstly, the service layer is often placed above the AS layer (Gerstner, 2003; Gao and Iyer, 2006), implying that it depends on the services provided by AS layer. However, Application Software is the final piece of technology connecting the digital solution to a user, and cannot serve any technological components on top of it. Secondly, the service layer contains third party support services that help to build or manage technological components in each of the four stack layers (Gerstner, 2003), and thus relates to all four layers of the stack, rather than just one. Due to these reasons, in this thesis the service layer is distributed along the stack. In the stack shown in Figure 1, each individual service layer component is contained in the layer where the corresponding technology resides. This collapses the service nature of these components, but keeps their technological relatedness intact. In practice, this means that technological capabilities are treated similarly to technological assets - after all, technological capabilities enable these assets to be built.

The stack model has important implications for structure of the industry competition (Gao and Iyer, 2006). In the lower layers technologies serve as a foundation for new software to be developed on top of, and a key success factor for companies here has been the ability to establish highly integrated platforms with high switching costs (Gao and Iyer, 2006). However, in the AS layer at the very top, there are no technological components to provide the services to, and thus the competition is focused on attracting end users. This dynamic makes the technological components business-to-business (B2B) offering in all but the highest AS layer, where also business-to-consumer (B2C) offering is present.

Companies can offer third parties individual components from specific layers, up to complete digital solutions built from components across all layers, to allow them to provide digital products or services. Furthermore, companies can also focus on building their own software stack, focusing on providing services to end users with it. However, there is no limitation to doing both, as companies can both use their own stack with some own components to provide digital services to end-users, as well as providing individual components or groups of them to third party companies. However, offering stack components to third party companies is a two-way street. In the mobile ecosystem, opening platform resources can simultaneously help extract appropriated relational rents, as well as expose the platform to exploitative competitive attacks like platform forking (Karhu, Gustafsson and Lyytinen, 2018). Additionally, opening some components to third parties can be beneficial to both parties, whereas providing others might create a competitive threat to the potential buyer of the component. In the case of IBM in 1980s and 1990s, their presence in AS layer hurt their business opportunities in providing their components from lower layers to competing companies as they were simultaneously potential suppliers and competitors (Gerstner, 2003). However, this was the case for IBM whose main business is selling software and hardware systems rather than to provide software-enabled user-facing service. In the case of companies like Google, Apple, Facebook, and Amazon, presence in multiple layers is less likely to cause conflicts, as their most important customers are users. Rather, their presence in multiple layers might be a necessity to be able to provide their service to end users.

Another consequence of the layer interaction dynamics is that the number of technology components grows higher when moving up in the stack. In general, when developing a digital service, the more re-usable components are used, the faster the execution. In an optimal case only AS software is developed, and no new technology is created to MW, SS, and HW layers. In the software stack, components need to be compatible with the components one layer below, and lower level components are often maintained as platforms. For example, operating systems in SS layer foster a community of developers that develop compatible Middleware Services components for them. Increasing the amount of operating systems would create the need to re-create the MW components, thus keeping the switching costs high in lower layers, and keeping the amount of technology there lower than higher layers. However, this effect is offset to an extent when distance between components in the stack grow larger, as a longer distance reduces the need to adjust the component in higher layer when a lower level component changes. Regardless, in the AS layer there is no next layer that would depend on the AS software, which allows a large variety of AS to be created, but also makes AS less unique than software in lower layers. Acquiring a company focusing in the AS layer is thus more likely to be beneficial due to gaining access to the users of the technology, rather than its value as a scarce, hard to imitate IS asset.

2.3 Hypotheses generation

As scalable MSPs are based on technology, they have a platform core that consists of components in certain layers of the software stack. At their early days, platforms should place focus on acquiring companies with technology in these core layers of the platform. By utilizing a coring strategy, platforms can utilize IS technical skills and IS infrastructure in establishing a unique and compelling value proposition fundamental to the platform (Gawer and

Cusumano, 2008). Tan et al. (2015) find Alibaba to have leveraged experience and technical expertise to develop IS infrastructure on their online platform in its nascent stage of development. In support, Hagiu (2007) argues that platforms should be careful when considering horizontal expansion, because “it needs to trade off the synergies, economies of scale and/or network effects created by novel search or shared costs reductions against the increasing complexity costs and diseconomies of specialization, which occur when the platform acquires new dimensions”, and suggests that instead of expanding to a MSP, a dominant two-sided platform could be enough. Hagiu (2007) further suggests that before seeking to expand with new functionalities, platforms should first focus on developing their core platform. To enable this focused development, firms can utilize acquisitions as a means of innovation (Puranam and Srikanth, 2007) or to substitute internal R&D (Bower, 2001), but also to simply obtaining engineering capabilities (Cohen, 2012). However, Santos and Eisenhardt (2009) found that entrepreneurial companies also acquire potential entrepreneurial rivals to ensure they won’t outcompete them, meaning that these targets are also technologically related to the acquirer. In either case, research suggests platform companies should first focus on acquiring companies from same stack layers, leading to the hypothesis:

Hypothesis H1: *In the earlier stages of platform development, platform leaders acquire targets with technology at the acquirer’s platforms’ core layers.*

To gain competitive advantage in the long term, research suggests that platform companies should seek to improve their speed and ability to improve their platforms. Yang, Nam and Kim (2017) suggest that keystone firms in mobile ecosystem should acquire companies that allow them to develop and grow their main business areas, especially the platform. Furthermore, they indicate that platform enhancement could be the most important factor in gaining competitive advantage in the mobile ecosystem. Hagiu (2007) argues that the most successful MSPs are constantly evolving by increasing their depth and/or reach, while redefining their own and industry boundaries in the process. Koch and Windsberger (2017) similarly propose that in environments of high digitalization, firms can gain sustained competitive advantage if they actively shape their competitive environment and co-create value with interconnected firms. Tan et al. (2015) also suggest two strategies for a mature stage platform: a meshing strategy of fostering solidarity and mutual dependencies between the platform members, and an empowering strategy where the platform members' ability to participate and contribute on the platform is enhanced.

Companies have long suffered from overlapping work, as multiple parallel projects continuously rediscover and reinvent core concepts in writing the Application Software, slowing down development speed and increasing the costs (Schmidt and Buschmann, 2003). All technology in layers other than AS are reusable by nature, as they provide services to components in their own layer or the one above. However, as most software is developed in the AS layer, in general the largest benefit to software development speed should be with middleware, which by Schmidt and Buschmann's (2003) definition is essentially reusable software. MW components can help to improve the innovation speed of the platform owner, but also the innovation speed of certain platform participants, if the components are released to their use. These considerations regarding the innovation speed and middleware's reusability lead us to the hypothesis:

Hypothesis H2: *In the later stages of platform development, platform leaders each acquire targets with reusable software components to increase their ecosystem's innovation speed.*

The software stack model also links together similar technologies across different platforms, regardless of the domain they are used in. The interoperability of software is solved with middleware, which is "reusable software that leverages patterns and frameworks to bridge the gap between functional requirements of applications and the underlying operating systems, network protocol stacks, and databases" (Schmidt and Buschmann, 2003). MW provides services to help both the MW and AS layers. However, MW can also benefit lower SS level offerings by being bundled together with them. For example, a machine learning library in the MW layer could be bundled up with SS level cloud computing platform, offering the library only for customers of the cloud computing platform, and thus creating lock-in to the cloud platform for anyone who uses the library. SS layer is also located in the stack between two other layers, and technologies in the layer could similarly create value to multiple platform cores. Thus, the more platform cores a company has in any of the layers of the software stack, the more synergy potential technology acquisitions can have to the company. In practice, such synergies could be gained with MW acquisitions when the acquirer has AS and SS cores, and with SS acquisitions when the acquirer has MW and HW cores. A company naturally builds more IS assets as it develops, and hence platforms at a later stage of development should receive more benefits from technology acquisitions. These considerations lead us to the hypothesis:

Hypothesis H3: *In the later stages of platform development, platform leaders acquire targets with technologies that simultaneously provide benefits to multiple of the acquirer's platforms' core technologies.*

While acquisitions are often studied from the perspective of acquirers and targets, they are not isolated events in a static competitive landscape, and thus the competitive dynamics need to be considered. Acquisitions related to another company's businesses are perceived as a larger increase in competitive tensions and threat, which prompts more complex competitive response (Uhlenbruck *et al.*, 2017). Similarly, Uhlenbruck et al. (2017) find less related mergers with less resource similarity to have the opposite effect as they appear to loosen competitive tensions. Companies use acquisitions to enhance their power and eliminate competitive threats, especially when the targets could be used by a competitor as a market entry 'stepping stone', or if the target itself is a potentially serious rival (Santos and Eisenhardt, 2009). Platform companies are under competitive pressure to expand into new functionalities or customer groups, as competing platforms can attack your home base by expanding in the reverse direction (Hagiu, 2007). New IS capabilities might be required for the expansion, and Cohen (2012) identifies acquisition often as the fastest, if not the only, way to keep up with technological developments. Platform companies could thus use strategic acquisitions to prevent competitors' access to the IS capabilities needed for hostile platform envelopment attacks.

Just as technology fundamentally enables MSPs, it also allows them to expand. Digital technologies develop at a fast pace to directions hard to predict, and talent is scarce. In this environment, acquiring a technology can mean the ability to deliver a new feature or functionality, but also that a competitor will struggle to do the same. As GAFA, the case companies in this thesis, compete against each other in fields like Social Media, Mobile devices, Advertising, Virtual assistants, and Cloud, among others, they are good examples of companies operating competing platforms, thus being in a common platform war. Gawer and Cusumano (2008) suggest the copying and development of new features as a key strategy to win platform wars. Especially when their user bases overlap, platform companies face both a risk and opportunity of envelopment as users are immediately given access to use a functionality in an alternative platform. However, the technologies enabling the envelopment opportunities can be very specific, whereas the stack model lacks the granularity to make a difference between them. Based on these findings and considerations, the following hypothesis is constructed:

Hypothesis H4: *In the later stages of platform development, different platform leaders with overlapping user bases acquire targets with technology assets in similar kinds of technologies.*

3 Methodology

This thesis takes a multiple case study approach to understand why platform leaders acquire technology companies. The study combines both qualitative and quantitative methods, and this section describes the research methodology in detail.

3.1 Case companies and data

Apple, Facebook, Google (Alphabet), and Amazon were selected as the case companies based on the dominant position of their ecosystems in industries such as Cloud computing, eCommerce, Computer devices, Social networks, and Search. At the time of writing this thesis, Google is a company under the corporate parent Alphabet, but in this thesis the name Google is used to refer to the full company portfolio of Alphabet. The M&A deal information used in this thesis originates from Zephyr M&A database, and the data processing is outlined in Table 1. Deals were searched with the company names shown in Table 1, limiting data to deals with assumed or confirmed completion date between 1/1/1900 and 31/10/2017, and including only acquisitions where the acquirer reaches a 100% ownership of the target company. Only fully acquired targets are considered, because full ownership is often required for fusing the target and its technological assets completely to the acquiring company. Additionally, there were no acquisitions fitting these search criteria with Alphabet Inc. as the acquirer, and thus only acquisitions made by Google Inc. are considered.

After receiving this data from Zephyr, deals with no completion date were excluded. Finally, information about each deal company was retrieved and coded as outlined in section 3.4 Data analysis below, and non-technology related deals were excluded to reach the final number of 324 acquisitions.

Table 1 Deal data selection

Number of deals	**Amazon.com**	**Apple Computer Inc.**	**Facebook Inc.**	**Google Inc.**
All M&A deals	168	119	84	273
Excluding out of time range and non-completed	114	82	67	218
Excluding non-Acquisitions	54	69	65	170
Zephyr total	54	69	65	170
Excluding blank dates	52	67	55	155
Excluding non-technology and unknown companies	49	66	55	154
Final acquisitions	49	66	55	154

To support the hypothesis testing, recent revenue data was also collected from the annual reports of the case companies, together with the distribution of the revenue to the company's segments. This revenue data serves to help analyze what technology layers are core to the case companies.

Acquiror name	Target name	Target primary business description	Target business description(s)	Primary layer
FACEBOOK INC.	WHATSAPP INC.	Online cross-platform mobile messaging software developer	Online cross-platform mobile messaging software developer	Application software
FACEBOOK INC.	INSTAGRAM INC.	Online photo sharing platform operator	Online photo sharing platform operator	Application software
FACEBOOK INC.	LIVERAIL INC.	Online video advertising platform operator	Online video advertising platform operator	Middleware services
FACEBOOK INC.	ASCENTA (UK) LTD	Drone manufacturer	Drone manufacturer	Hardware
FACEBOOK INC.	LIBERTY ACQUISITION SUB II LLC	Performance analysis and monitoring software developer	Performance analysis and monitoring software developer	Middleware services

Figure 2 Acquisition data snapshot

An Excel snapshot of some relevant fields of the data is shown in Figure 2. The fields for acquirer, acquisition target, and their business descriptions are directly given by M&A deal database Zephyr. The data in primary layer field, which illustrates the acquisition target's key layer of technology, is produced in a process detailed in section 3.4 Data analysis below.

3.2 Stages of platform evolution

To make a difference between platforms at different stages of development, scholars have suggested multiple alternative stage models, as well as a continuous model of platform evolution (Staykova and Damsgaard, 2017). Research suggests that successful platform companies seek to continuously improve their speed and ability to improve their platforms, and as seen in Table 2, the case companies are still growing their revenues despite them being already significant. Thus, I argue that current platform evolution models are insufficient as platform leaders continuously develop their platforms. Instead, I propose to distinguish between two time periods, early stage and later stage, primarily based on the competitive dynamics outlined in Table 3 below. Hagiu (2007) suggests that platforms should first focus on developing their core platform before seeking to expand with new functionalities, and thus platforms can be seen to first develop to fulfill their core purpose, and later to expand and compete with other platforms. Similarly, Gawer and Cusumano (2008) structure platform strategies into creation of platforms with a coring strategy, and platform wars with a tipping strategy. Hence, platforms can be seen to go through two competitive phases: first, a phase of focused development where the company seeks to develop its core platform, followed by a phase of multi-platform competition, where companies compete with multiple other companies with potentially multiple different platforms.

Table 2 Growth rates and revenues of GAFA companies

	CAGR* 2012 - 2016	**Revenue 2016, $USD billion**
Google	15,8 %	~90
Apple	6,2 %	229**
Facebook	52,7 %	28
Amazon	22,1 %	136

*Compound Average Growth Rate
** Financial Year 2017, Q4/2016 – Q3/2017

This thesis seeks to uncover the acquisition strategies during platform wars, and thus it is necessary to observe acquisitions in a period when such wars are undeniably happening. While it is difficult to pinpoint an exact moment when platform competition between GAFA intensified, it is arguably clear that they were directly competing already in early 2010s. For example, Google launched Android to compete with Apple's iOS in 2008 (Google, 2008), Google Storage to compete with Amazon's cloud offerings in 2010 (Kincaid, 2010), and social network Google+ in late 2011 to compete with Facebook (Halliday, 2011), while also facing long-term competition from Facebook in online display advertising, and Amazon in product search advertising. To account for any lag in strategy development and deployment, as well as lead times in negotiating and preparing acquisitions, acquisition behavior should be affected by these and many other attempts of platform envelopment by at least end of 2012. The competition has all but eased later on, as for example the GAFA are currently all developing technology in the Virtual assistant field (Amit, 2017). Thus, this period of intensified competition is arguably depicted by acquisitions completed from at least 2013 to 2017. Hence, deals are grouped into two time periods:

1) Deals completed during 2012 or before, denoted as *early stage*, depicting a phase of focused platform development
2) Deals completed during 2013 or after, denoted as *later stage*, depicting a phase of multi-platform competition

The characteristics of these stages are shown in Table 3. The early stage depicts the characteristics of an entrepreneurially developed platform, and thus might differ from a platform developed by an established company. In the early stage, the priority is to make sure the platform works for what it was built to do. This involves acquiring users/other participants, and focused development of platform core. As the scope is strict and resources limited, competitively the focus is to react to immediate threats, also highlighted by the coring strategy employed by the companies at this stage. At the later stage, the platform's strategic focus has shifted into exploration of new functionalities. With some success already achieved, the platform is better resourced for this exploration. Competitively the focus shifts more to active strategizing, and platform envelopment is utilized to attack competing platforms. At this stage, there can also be more defensive competitive actions to protect the platform from immediate and future envelopment attacks.

Table 3 Strategies of early and later platform stages

	Early stage	Later stage
Strategic focus	Ensuring platform serves its core purpose, platform monetization	Exploring ways to further enhance and expand the platform, and to protect from envelopment attacks
Competitive strategy	Reactive	Active
Platform strategy	Coring	Tipping/Envelopment

3.3 Hypotheses testing

This thesis tests four individual hypotheses, which are outlined together with their corresponding test variables in Table 4. The key underlying attribute used in testing each hypothesis is the number of acquisitions. The variable is chosen as this thesis seeks to understand what kinds of companies platform leaders acquire. The variable represents the intensity of acquisitions, and thus enables us to evaluate the relative importance of different types of acquisition targets. Deal size in terms of monetary or employee count could be alternative variables of interest, but is not used in this thesis. This is because technology acquisitions are usually characterized by young, entrepreneurial targets (Cohen, 2012), and where acquiring relatively small companies for their talent is frequent (Coyle and Polsky, 2013). Target companies that have talent in a quickly developing and advanced field, such as AI, are often smaller as their technology might not be mature enough for a scalable business model. Hence, using deal size would mean that a few large acquisitions, like Facebook's 19 $USD billion acquisition of WhatsApp, would hide any meaningful insights of the full spectrum of a technology company's acquisition behavior. Additionally, technology companies frequently keep acquisition details private, and using deal size as the variable would force the use of less reliable estimates by the media to access the data.

Table 4 Hypotheses and test variables

	Hypothesis	Test variable
H1	*In the earlier stages of platform development, platform leaders acquire targets with technology at the acquirer's platforms' core layers*	Share of acquisitions in platform core layers at early stage
H2	*In the later stages of platform development, platform leaders each acquire targets with reusable software components to increase their ecosystem's innovation speed*	Share of acquisitions in Middleware Services layer at later stage, and changes in both deal counts and shares at layers between early and late stage
H3	*In the later stages of platform development, platform leaders acquire targets with technologies that simultaneously provide benefits to multiple of the acquirer's platforms' core technologies*	Share of acquisitions in layers sandwiched by core layers at later stage, and changes in both deal counts and shares at layers between early and late stage
H4	*In the later stages of platform development, different platform leaders with overlapping user bases acquire targets with technology assets in similar kinds of technologies*	# of acquisitions in the same fields by competing companies

All the hypotheses are generated in the section 2.3 Hypotheses generation. Due to the farming of the hypotheses, hypothesis H1 analyzes the deals with their completion date in the early stage, but hypotheses H2, H3, and H4 focus on the data from the later stage. Hypothesis H1 uses the percentage of acquisition at platform's core layers as the test variable, which derives directly from the hypothesis as discussed in section 2.3 Hypotheses generation, and uses an additional analysis defining what the companies' platform core layers are. Hypothesis H2 concerns the reusable components, potentially benefitting both the platform leaders and their platform complementors, and is measured by percentage of all acquisitions in the middleware layer, because as discussed in section 2.3 Hypotheses generation, Middleware Services components have the most reusability potential of the stack layer. It could be argued that system software components are also reusable, as they can certainly provide services to multiple Middleware Services components. However, system software components have been left out as the hypothesis deals with innovation speed, and as there are far less Middleware Services than there is Application Software, MW components carry significantly more potential to improve a platform's total innovation speed.

Similarly, hypothesis H3 is tested with the stack model, using the percentage of acquisitions located on layers between a company's two core layers, using the additional analyses of the companies' platform core layers as used in hypothesis H1. For H3, MW and SS layer acquisitions are the focus, as they are the only layers that have layers both above and below them. Hypotheses H2 and H3 also reflect on the change in acquisition amounts and shares in stack layers between early and later stages, because it serves to highlight the changes in acquisition behavior between the stages. This in turn adds more context around the later stage figures, helping to understand how to interpret the figures and what the magnitude of the shift is. Additionally, taking the absolute number of deals into account in explaining the changes in the shares of acquisitions helps to avoid misinterpretation of the data.

Unlike the other hypotheses, hypothesis H4 is tested with the number of technology categories companies have in same technology fields. The technologies enabling the envelopment strategies used by the case companies can be very specific, whereas the stack model lacks the granularity to make a difference between them, a shortcoming also identified by Gao and Iyer (2006). One might argue that other layers have important technology, but as illustrated by the data of this thesis, the case companies all put increased focus on middleware at the later stage, implying that the layer is especially important for them all. Hence, only the acquisitions in middleware layer are categorized to more granular technology groups for further analysis, and are used to test hypothesis H4 by analyzing the overlaps of acquisitions in the same technology categories.

3.4 Data analysis

After the initial data collection outlined in section 3.1 above, the case companies' current business segments as of late 2017 were coded into the stack layer. This analysis utilized publicly available sources of the companies' offerings, as well as the revenue and other data describing the company's business from their annual reports.

Acquisition targets were then individually coded into a layer in the software stack based on the description of their business. Previous studies utilizing the stack model use industry codes like Standard Industry Codes (SIC) to categorize companies into layers (Gao and Iyer, 2006), but the industry categories can be very generic and inaccurate, and thus risk the data validity if used. Although a highly laborious process, each acquisition target was categorized manually to avoid the data validity problem. As the targets are often small companies, the deals are coded to a single key layer based on where the target company's key unique technical assets or capabilities reside. The layers and the stack model are described in detail in the section 2.2 Software stack perspective to acquisitions on platforms. Business descriptions from Zephyr were the primary source of description data, but for 55% of the deals they were insufficient and thus supplemented with secondary information from company websites and other online sources. The distribution of data source for coding is shown in Table 5.

Table 5 Business description data sources

	Amazon.com	**Apple Computer Inc.**	**Facebook Inc.**	**Google Inc.**	**Total**
Zephyr	32	13	40	61	146
Media/Web	17	53	15	93	178
Total	49	66	55	154	324

After coding acquisition targets to the stack layers, the categorized deals were analyzed by case company, using the tests outlined in section 3.3 above.

After analyzing the deal data from the stack layer perspective, deals in the middleware category were coded further into specific areas of technology. The deals were first openly coded technology categories, and the first created technology categories were then further collapsed into fewer final categories where initial categories had significant overlaps. This data was analyzed by looking at all four case companies simultaneously. The acquisitions were each grouped into one technological group based on the information about the acquisition target's technological focus. However, it is important to note that these categories do not dictate how the technology will be used, but rather, the technology categories provide proxies to what the specific technology is able to do. For example, visual recognition technology can be used in multiple ways, and thus could support for example Search or AR/VR technologies, which are separate categories.

4 Findings

In this section, I first introduce each case company and the distribution of their business along the software stack, and analyze their acquisition behavior individually. After the case company specific view, I analyze the acquisition behavior of all the case companies together.

4.1 Four cases

This section introduces each case company, explaining the results from the perspective of each individual company, covering the hypotheses H1, H2, and H3.

4.1.1 Google

Founded in late 1998, Google is best known for its internet products like the Google Search, but over time has expanded operations to areas quite far afield from its main internet products (Page, 2015; Alphabet, 2017a). While formally Google is owned by its parent company Alphabet, in this thesis any offerings under Alphabet's portfolio are referred to as Google offerings. Most of Google's revenues comes from its advertising business in the MW layer, but it also has an emerging cloud business in the SS layer, Virtual assistant and Mobile devices in the HW layer, as well as SS in the Android mobile phone operating system. Regardless, Google's business is still heavily focused on the AS and MW layers of the software stack.

Table 6 Main revenue sources of Alphabet in 2016 (Alphabet, 2017b)

Layer	**Business segment**	**Share of revenue**
AS	Google Search, Gmail, Google Maps, …	-
MW	Advertising*, Google Play store	88% 0 - 12%
SS	Google Cloud, Android	0 - 12%
HW	Devices	0 - 12%
Total		~90$USD billion

*Includes only revenue from 3rd party ad placements, own ad placements allocated to AS

Table 6 shows the distribution of Google's corporate parent Alphabet's revenues by business segment, and shows how these segments are distributed across the software stack. While it clearly highlights how important advertising is for Google, it is important to note that not all revenue is generated by Google's own AS properties - advertising on Google's own and third party properties accounted for 71% and 17% of Alphabet Inc.'s revenues respectively in 2016 (Alphabet, 2017b). However, Google's own AS remains the most important source of its advertising space. As Google's focus was in advertising for quite long and the new offerings have taken time to show in their bottom line, I consider the AS and MW layers as Google's core layers in the early stage, but the entire stack as core in the later stage.

In the case of Google, AS contains its own end user facing services such as Google Search, which are its most important source of advertising space. On the other hand, MW contains the advertising engine that generates the revenue and serves ads to both the different AS's of Google, as well as third party AS's that provide the rest of Google's advertising space. However, Google as a case highlights the complexity of the linkages between technological layers, as having the Android OS in the SS layer enables Google to get revenues from the Play Store MW. Similarly, Google's own AS enables it to generate its revenues with its advertising MW. In Table 6, the revenue is allocated to the layer that powers the monetized interaction.

Table 7 Google's acquisitions at early and later stages

	Number of acquisitions		Share of acquisitions	
Layer	**Early**	**Later**	**Early**	**Later**
AS	26	7	29 %	11 %
MW	45	45	51 %	69 %
SS	14	9	16 %	14 %
HW	4	4	4 %	6 %
Total	89	65	100 %	100 %

Looking at the acquisitions of Google in Figure 3 and Table 7, before 2009 Google had an acquisition intensity of 10 or fewer per year, which then accelerated to 27 acquisitions in the peak activity years 2010 and 2014. Table 7 also illustrates the focus of Google's acquisitions in its early stage, with 80% of acquisitions in the AS and MW layers where Google's core business technology resides, supporting the H1 hypothesis.

However, Google's emphasis between the AS and MW layers has shifted between early and later stages. The share of AS acquisitions dropped from 29% to 11%, and MW increased from 51% to 69% between these two periods. The high share of middleware acquisitions in the later stage supports hypothesis H2. On the other hand, in the SS and HW layers acquisition intensities have remained small but rather constant, with SS acquisition intensity changing from 16% to 14%, and HW from 4% to 6% between the time periods. The increase in the share of MW acquisitions is mainly due to an increase in the amount of MW acquisitions per year, climbing from 4.50 acquisitions per year at early stage to 11.25 acquisitions per year in the later stage.

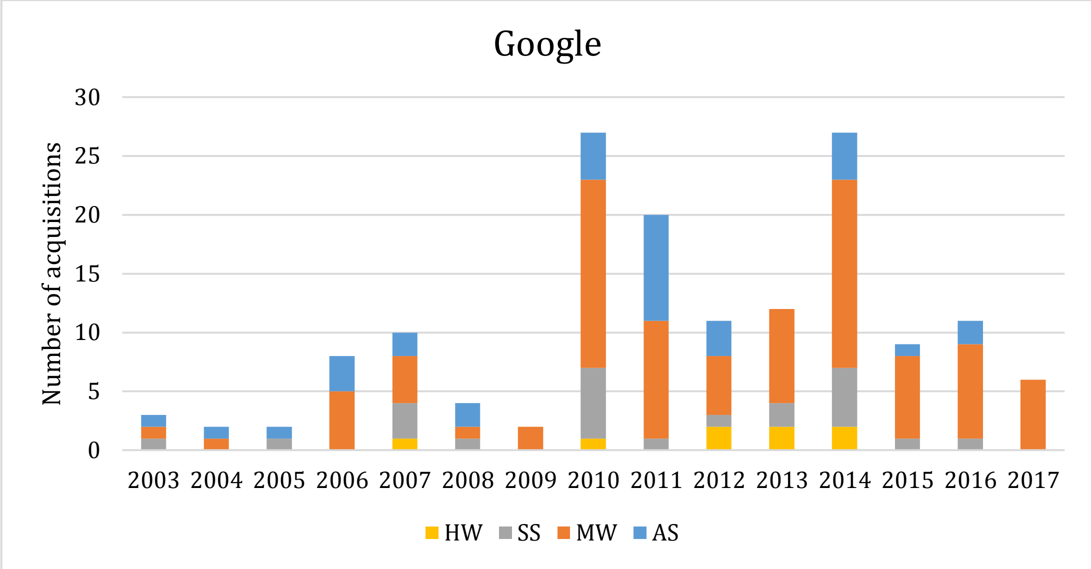

Figure 3 Number of Google's yearly acquisitions by stack layer

MW and SS layers, which are sandwiched between Google's core layers, accounted for 83% of all acquisitions in the later stage, and Google can thus receive synergistic benefits from these acquisitions. However, this was driven by MW acquisitions, while SS acquisitions reduced in both absolute numbers and share, suggesting that SS acquisitions might not be as beneficial. Thus, the results do not support hypothesis H3.

4.1.2 Apple

Apple Computer Inc. was founded in 1976 as a company developing computer systems, but has since expanded to new fields like, operating one of the most successful mobile platforms, and entertainment (Rawlinson, 2017). As seen in Table 8, while Apple's ecosystem has expanded to include products and services in all layers of its stack, it still made 199$USD billion or 87% of its revenues from HW layer device sales on fiscal year ending Sep. 30th 2017, iPhone accounting for the majority of it (Apple, 2017). In the same period, revenue from services 30$USD billion accounted for the remaining 13% of Apple's revenues. While these figures highlight how critically important HW is for Apple, it is important to note that Apple's current ecosystem could not exist without MW layer components that generate the network effects in the ecosystem. While SS level operating systems are crucial to the devices in making them different from competition, MW level services like the App store play a critical role in the device user experience and generate considerable revenues for Apple. While the service revenue was 12$USD billion or 8% of Apple's revenues in financial year 2012 (Apple, 2012), I interpret MW as core only at the later stage. Thus, Apple's core layers at early stage are HW and SS, and HW, SS, and MW at later stage.

Table 8 Main revenue sources of Apple in FY2017 (Apple, 2017)

Layer	**Business segment**	**Share of revenue**
AS	-	-
MW	Apple Pay Digital Content and Services	13%
SS	iOS, OS X ...	-
HW	Devices	87%
Total		~229$USD billion

Despite its long history, Apple has only really activated in making acquisitions in the 2010s, having made only a quarter of its acquisitions before the period as seen in Table 9 and Figure 4. Before 2013, Apple made 25% of its all acquisitions in the HW, dropping significantly to 12 % of all acquisitions in the period after, despite the magnitude of revenue made in this layer. Between the same periods the share of SS acquisitions fell from 21% to 17%, AS acquisitions grew from 4% to 10%, and MW acquisitions grew from 50% to 60% of all acquisitions. The high share of MW acquisitions at the later stage supports the hypothesis H2. For Apple, the increased share of MW acquisitions was due to an increase in the amount of MW acquisitions, climbing from 0.75 acquisitions per year before 2013 to 6.25 acquisitions per year in the period after.

Table 9 Apple's acquisitions at early and later stages

	Number of acquisitions		**Share of acquisitions**	
Layer	**Early**	**Later**	**Early**	**Later**
AS	1	4	4 %	10 %
MW	12	25	50 %	60 %
SS	5	7	21 %	17 %
HW	6	6	25 %	14 %
Total	24	42	100 %	100 %

The share of Apple's acquisitions support the H1 hypothesis to an extent, although the share of acquisitions at Apple's core layers of SS and HW total to 47% of all acquisitions at the early stage, and thus the non-core layers account for a 53% majority of acquisitions. However, as the software stack dynamics suggest, HW and SS companies are rarer than MW and AS companies, and in the case of Apple, the distribution of acquisitions is clearly skewed towards the lower layers.

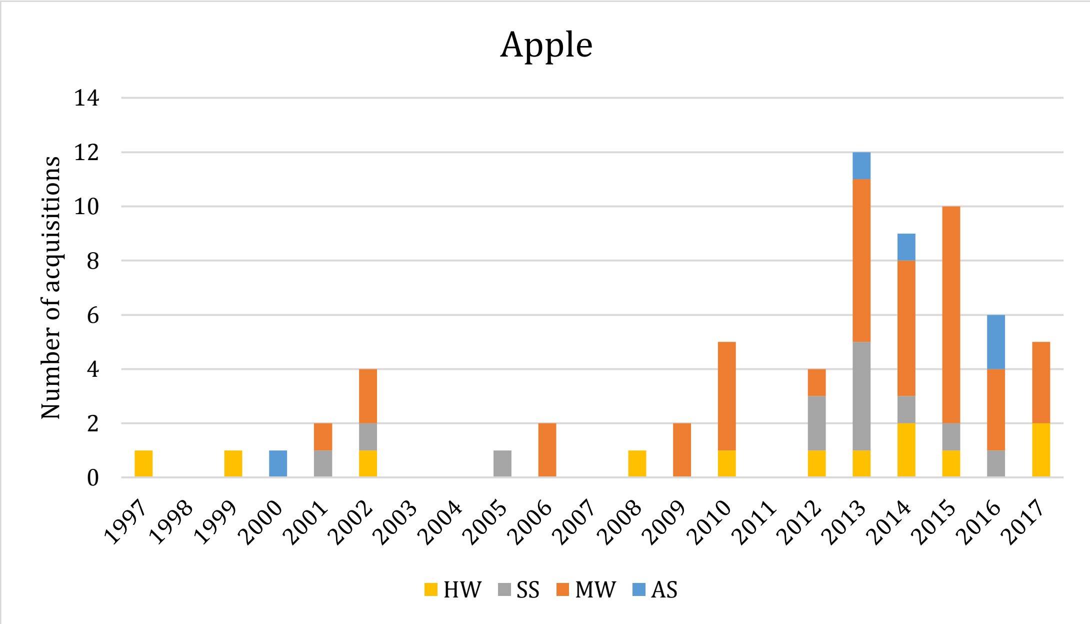

Figure 4 Number of Apple's yearly acquisitions by stack layer

Apple's later stage platform cores are in MW, SS, and HW, but their acquisitions in SS layer lost share, indicating that synergy potential would not drive acquisitions in sandwiched layers, suggesting hypothesis H4 should be rejected. However, this reduction was caused by the increasing total acquisition volume mostly in the MW layer, as SS layer acquisitions grew in numbers from 5 to 7 from early to later stage. Thus, results remain inconclusive for hypothesis H3.

4.1.3 Facebook

Founded in 2004, Facebook is known for its Social Media Network (Bellis, 2017). While the AS of the service is at the very core of Facebook, the monetization of the platform is done with MW. While Facebook also made efforts in developing MW for app development in its platform, 97 % of their

2016 revenue was brought in by their advertising MW that serves ads mainly to their own social media platform AS (Facebook, 2017). In contrast to Google, Facebook does not have significant revenues from serving advertisements on 3rd party AS. While MW can be seen as Facebook's key revenue source, their ability to generate revenue is tightly dependent on their ability to serve advertisements to their own AS, and thus its core layers are MW and AS.

Table 10 Main revenue sources of Facebook in 2016 (Facebook, 2017)

Layer	**Business segment**	**Share of revenue**
AS	Social media service	-
MW	Payments and other fees Advertising	3% 97%
SS	-	-
HW	-	-
Total		~28$USD billion

Aligned with Facebook's revenue sources, 95% of all its acquisitions seen in Table 11 and Figure 5 have been in the AS and MW layers. This strongly supports the hypothesis H1. While more of the acquisitions were AS in Facebook's early stage, the balance has shifted towards MW in the later stage. The share of AS acquisitions has dropped from 69% before 2013 to 34% after, while the share of MW has increased from 31 % to 55 % in the same period. The high share of MW acquisitions at the later stage supports the hypothesis H2. Facebook has also made two SS layer and one HW layer acquisitions, all in the period after 2013.

Table 11 Facebook's acquisitions at early and later stages

	Number of acquisitions		**Share of acquisitions**	
Layer	**Early**	**Later**	**Early**	**Later**
AS	18	10	69 %	34 %
MW	8	14	31 %	48 %
SS	0	3	0 %	10 %
HW	0	2	0 %	7 %
Total	26	29	100 %	100 %

The increase in the share of MW acquisitions is mainly due to an increase in the amount of MW acquisitions per year, climbing from 1.33 per year before 2013 to 3.50 per year during the period after. While these MW acquisitions are adjacent to Facebook's core AS layer and may complement technologies in Facebook's other core layer, MW, there is no apparent platform core at SS layer that these acquisitions could complement and thus the case is not applicable for testing hypothesis H3.

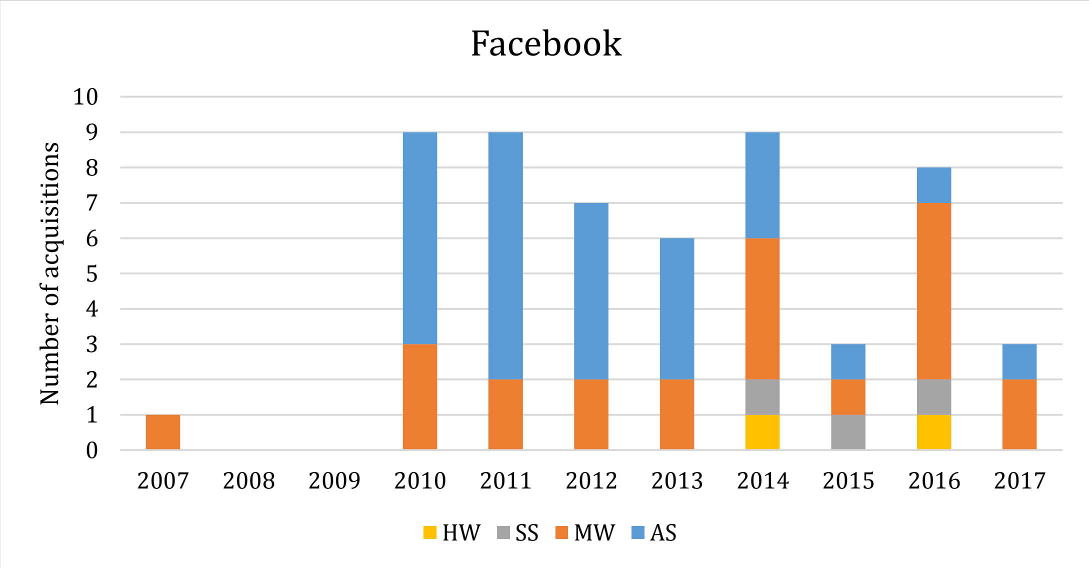

Figure 5 Number of Facebook's yearly acquisitions by stack layer

4.1.4 Amazon

Founded in 1995, Amazon started out as an online book retailer, but has since expanded to selling a variety of other goods online, providing cloud computing services, and to selling Kindle book reading devices (Hall, 2017). However, not all these segments are alike. Table 12 shows the distribution of Amazon's revenues and profits by its major business segments and highlights the key software stack layers of each segment. While Amazon makes 91% of its 2016 revenue with AS in its eCommerce segment and only 9% with SS in its Amazon Web Services (AWS), in terms of operating income they account for 26% and 74% of total respectively (Amazon, 2017). While Amazon has operated AWS since 2006 (Miller, 2016), its share of Amazon's total revenue was only roughly 3.6 % on Q4/2012 (Owen, 2013), and thus we argue it wasn't core to Amazon before the later stage. Additionally, the devices segment receives small attention in Amazon's annual report or reported revenue figures, and I argue that it isn't core to Amazon. Hence Amazon's core layers are AS in the early stage, and AS, and SS in the later stage.

Table 12 Main revenue sources of Amazon in 2016 (Amazon, 2017)

Layer	**Business segment**	**Share of revenue**	**Share of profit****
AS	eCommerce	90%	26%
MW	Advertising*	1%	-
SS	Amazon Web Services (AWS)	9%	74%
HW	Amazon Web Services (AWS) Devices	-	-
Total		~136$ USD billion	~4.2$ USD billion

*Revenue estimate by Barclays (Elder, 2017). eCommerce includes Advertising profits.
**Operating income

As seen in Figure 5, Amazon has been rather inactive with acquisitions before 2008, and in general has been quite focused on acquiring companies in the AS layer, which accounts for 87% of all its acquisitions at its early stage. This clearly supports hypothesis H1. However, this AS acquisition share dropped to 31% in the later stage. Simultaneously, the share of MW acquisitions increased from 9% to 54%, and share of SS acquisitions increased from 0% to 12%. The high share of MW acquisitions at later stage supports the hypothesis H2. HW acquisitions remained at 1 acquisition per period, corresponding to 4% of total acquisitions at each stage.

Table 13 Amazon's acquisitions at early and later stages

	Number of acquisitions		**Share of acquisitions**	
Layer	**Early**	**Later**	**Early**	**Later**
AS	20	8	87 %	31 %
MW	2	14	9 %	54 %
SS	0	3	0 %	12 %
HW	1	1	4 %	4 %
Total	23	26	100 %	100 %

The rise in the share of MW acquisitions is mostly explained by increased amount of MW acquisitions, which have increased from 0.14 acquisitions per year at the early stage to 3.50 acquisitions per year at the later stage. As MW is adjacent to the AS and SS layers that are core to Amazon at later stage, the MW acquisitions can synergistically provide benefits to multiple core layers of Amazon, supporting hypothesis H3. However, in the case of Amazon this result is limited to synergies from MW acquisitions and cannot fully support the hypothesis as SS synergy potential cannot be analyzed, and thus the result gives mixed signals.

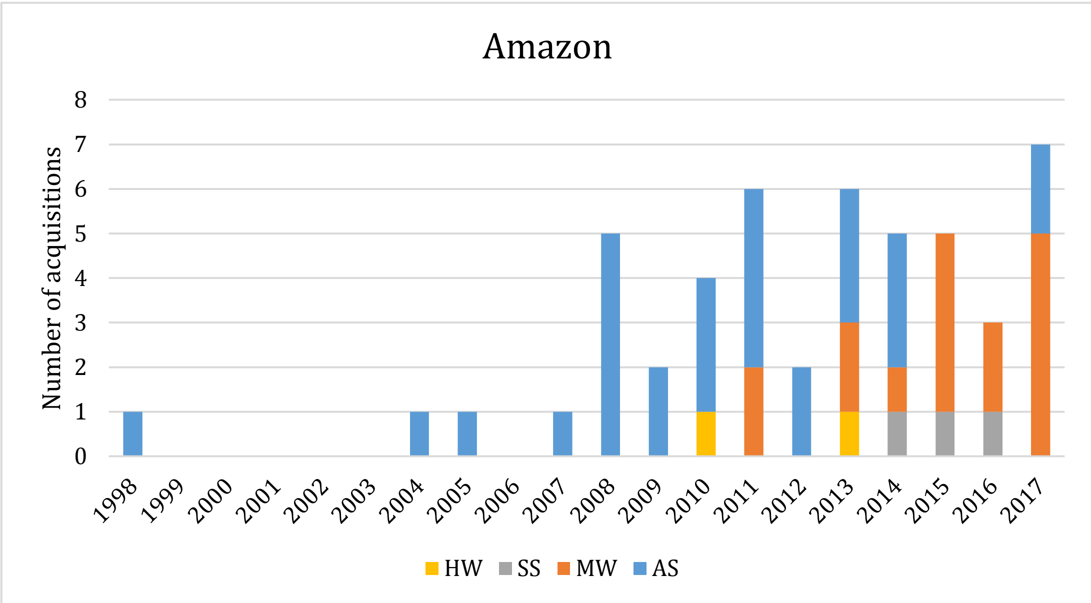

Figure 6 Number of Amazon's yearly acquisitions by stack layer

4.2 Cross-case findings

This section covers the results for testing hypothesis H4, and examines the case companies together, rather than separately. All the relevant case-specific insights are explained individually under the sub-sections of section 4.1 Four cases above.

While the case companies appear to similarly focus their acquisitions on their core technology layers, they have also increased their acquisitions of targets focusing in the MW layer, both in absolute amounts of acquisitions as well as share of all acquisitions. This section takes a deeper look at the kinds of technologies developed by the acquired companies in this layer, to further understand what makes MW interesting and if the interests are shared by the case companies at the later stage. The technological categories here reflect the technological focus of the target companies. Even though the target companies might have a very different use cases and industry focuses, the technologies are not bound by industry boundaries, and two acquisition targets in the same technology category with seemingly different focuses likely still have high technological relatedness. In addition, technologies from different categories can also be highly related and ultimately be used for the same use case, such as Speech Recognition/Generation and Virtual assistants. However, the categorization used here does not speculate on the use case of the technology, and does not always link these technologies. Hence, this categorization uncovers less relatedness than the technologies can potentially have.

Figure 7 shows all the middleware acquisitions made by the case companies at the later stage, grouping the acquired companies by their respective technology area. Most frequent categories with 15 acquisitions include Software (SW) development tools, which contain a variety of general technologies that directly enable faster SW development process and higher quality outputs. The same amount of 15 acquisitions is also reached by Visual Recognition, which contains technologies that enable the identification of objects from image or video data. All case companies have made acquisitions in both technology categories, highlighting a common interest in the technology.

These ‘M&A battles’ are characteristic of the MW acquisitions, and are found, at least to some extent, in most of the MW technology categories identified in this thesis. Figure 7 and Table 14 demonstrate these battles by showing the amount of acquisitions in each technology category.

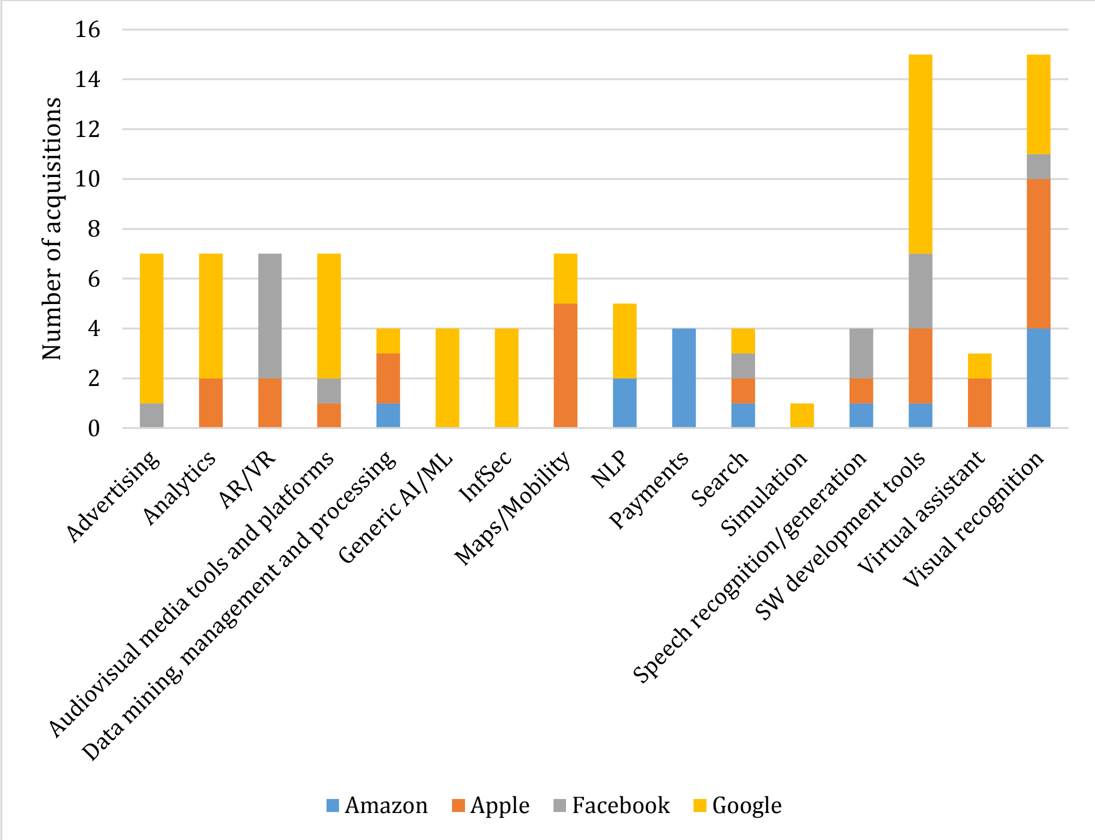

Figure 7 Middleware acquisitions at later stage

'acquisition battles' are seen in advertising technology between Facebook and Google, with one and six acquisitions respectively. This is the only category where Facebook and Google are the only ones of the case companies making acquisitions, which is logical considering that are the only ones with significant portions of their revenue being generated through advertising.

Apple and Google are battling in Analytics with two and five acquisitions respectively, but also in Maps/Mobility with five and two acquisitions respectively, and Virtual assistants with two and one acquisitions respectively. The Maps/Mobility and Virtual assistant acquisitions could demonstrate the competition in Mobile Operating Systems, while Virtual assistants also link to Smart Home solutions. The Analytics acquisitions relate to multiple sectors like entertainment and health, but are ultimately based on similar kinds of technologies.

Table 14 Middleware acquisitions at later stage

	Google	**Apple**	**Facebook**	**Amazon**
Advertising	6	0	1	0
Analytics	5	2	0	0
AR/VR	0	2	5	0
Audiovisual media tools and platforms	5	1	1	0
Data mining, management and processing	1	2	0	1
Generic AI/ML	4	0	0	0
InfSec	4	0	0	0
Maps/Mobility	2	5	0	0
NLP	3	0	0	2
Payments	0	0	0	4
Search	1	1	1	1
Simulation	1	0	0	0
Speech recognition/generation	0	1	2	1
SW development tools	8	3	3	1
Virtual assistant	1	2	0	0
Visual recognition	4	6	1	4
Total	45	25	14	14

Facebook and Apple compete in AR/VR, where both have made five and two acquisitions respectively. Facebook could utilize such technology for improving the user experience on its platform, while Apple could benefit from the technology in developing the user experience of its mobile phones.

Two technology categories had attracted acquisitions from three of the case companies. Amazon, Apple, and Google have targeted companies in audiovisual media tools and platforms –category one, two, and one times respectively. Speech recognition/generation technologies on the other hand has attracted

Amazon, Apple, and Facebook to acquire one, one, and two companies respectively.

Three categories, however, have acquisitions from each of the case company. Amazon, Apple, Facebook, and Google all had 1 acquisition in Search, which is a very general purpose technology. SW development tools had one, three, three, and eight acquisitions respectively, while Visual recognition had four, six, one, and four acquisitions respectively.

The data also highlights that every platform leader is acquiring technologies related to developing superior user interface and user experience, be it visual, written, or spoken methods. On the visual side, Facebook and Apple are buying Virtual Reality / Augmented Reality technologies, and all case companies are buying Visual recognition technology. On the written and spoken side, Google and Amazon are buying Natural Language Processing (NLP) technologies, Apple, Facebook, and Amazon are buying Speech recognition or generation technologies, and Google and Apple are buying Virtual assistant technology. While these technologies enable many functionalities, they can all be used for improving user interactions with a platform.

Table 15 Overlapping technology categories in MW acquisitions

	Google	Apple	Facebook	Amazon
Google		8	5	5
Apple			6	5
Facebook				4
Amazon				

Table 15 summarizes the amounts of overlapping technology categories, and highlights overlapping acquisitions between each pair of case companies, each such pair having four to eight technology categories that are present in acquisitions of both companies. With 16 total technological categories, there is a clear tendency to acquire similar technologies, supporting hypothesis H4.

4.3 Findings summary

This section draws from the analysis hypotheses presented in section 4.1 Four cases above to summarize the results for each hypothesis. The hypotheses and their test variables are summarized in Table 16, and the results of the testing are summarized for each case company in Table 17. I find support across the cases for hypotheses H1, H2, and H4, but for H3 the results are mixed and point towards rejection of the hypothesis. While it can be argued that the software stack generalizes technologies too much, because a single software stack layer might include a multitude of different technologies that might not be as related, the hypotheses arise from existing research and models. Thus, the results still serve to provide some validation to the existing research in the stack model context, as well as to add validity to the stack model as a framework to understand technology-based platforms.

Table 16 Summary of hypotheses

	Hypothesis	Test variable
H1	*In the earlier stages of platform development, platform leaders acquire targets with technology at the acquirer's platforms' core layers*	Share of acquisitions in platform core layers at early stage
H2	*In the later stages of platform development, platform leaders each acquire targets with reusable software components to increase their ecosystem's innovation speed*	Share of acquisitions in Middleware Services layer at later stage, and changes in both deal counts and shares at layers between early and late stage
H3	*In the later stages of platform development, platform leaders acquire targets with technologies that simultaneously provide benefits to multiple of the acquirer's platforms' core technologies*	Share of acquisitions in layers sandwiched by core layers at later stage, and changes in both deal counts and shares at layers between early and late stage
H4	*In the later stages of platform development, different platform leaders with overlapping user bases acquire targets with technology assets in similar kinds of technologies*	# of acquisitions in the same fields by competing companies

The data supports the hypothesis H1, suggesting that platform leaders at their early stage acquire companies with technology in their core layers. Google, Facebook, and Amazon had 80 to 95% of their acquisitions in these core layers, although Apple only had 47%. However, Apple's core layers are lower in the stack where the stack model suggests acquisition targets are rarer, and thus the 47% share can be seen to at least partially support the hypothesis as well.

The data also supports hypothesis H2, suggesting that technology acquisitions can serve a role in platform leaders' attempts to increase their ecosystem's innovation speed. The share of MW acquisitions was 54-69% for Google, Apple, and Amazon, while Facebook had a slightly smaller share of 48%. However, Facebook is the youngest of the case companies, and might lag behind the other case companies in its phase of development. Additionally, Facebook grew its share of MW acquisitions from 31% to 48%, showing an increased interest in MW acquisitions. This growth of the share of MW acquisitions was also visible for all other case companies, supporting the notion that innovation speed becomes more important when reaching a stage of multi-platform competition.

Table 17 Summary of results

	Google	Apple	Facebook	Amazon
H1	X	(X)	X	X
H2	X	X	(X)	X
H3	--	( )		( )
H4	X	X	X	X

X = Supports
(X) = Partially supports
( ) = Mixed signals
-- = Does not support
= Not applicable

The data does not support hypothesis H3, suggesting that platform leaders might not acquire companies in technology layers sandwiched by the acquirer's platform core layers in hopes of synergies with platform core layers. In the case of Amazon, some support was found for such benefits in MW acquisitions, as their share grew significantly between early and later stage. However, Amazon does not have synergy potential in acquiring SS layer targets as it does not have the HW layer as core. In the case of Google both MW and SS layer synergies were possible. However, Google's MW acquisitions increased, but the SS acquisitions reduced in both share and count, ultimately suggesting a reversed impact. In the case of Apple, the results remained mixed for SS layer acquisitions, and MW layer was not applicable. The test was not applicable to Facebook, which does not have any core layers beyond AS and MW, making it impossible to acquire companies with technology in a layer sandwiched between Facebook's core layers. However, all companies had a rather high share of MW acquisitions at the later stage, despite only two of them had platform cores in AS and SS, suggesting that the synergy potential is not a driver of platform leaders' technology acquisitions.

The data points consistently towards accepting hypothesis H4, suggesting that platform leaders make technology acquisitions in same fields as their competitors as a competitive measure. The competition is also observed between each pair of case companies, each such pair having four to eight technology categories that are present in acquisitions of both companies. Some of these overlaps happened with only a single acquisition by one or more companies, but the overlaps still signal competition, as the technological fields are mostly scarce in talent and companies and more attractive targets might simply not be available.

5 Discussion and conclusions

This thesis set out to answer the question '*Why do platform leaders acquire?*', approaching the question through the technologies of the acquisition targets. However, the findings also provide a new perspective to the strategy employed by platform leaders. While four platform leaders were studied, they represent successful platform companies, indicating that their approach to acquisition is beneficial to other platform companies as well.

Most importantly, this thesis finds strong evidence that Middleware technology has become strategic for platform leaders during platform wars. Furthermore, the findings suggest that unique middleware could generally be seen as the most important type of technology for the success of platforms. The empirical findings demonstrate that platform leaders put increased focus in MW acquisitions when fighting platform wars. This finding was consistent in all cases, regardless of the stack layers that were previously important to them, suggesting that platform companies should eventually need to develop a richer and more unique middleware layer to their software stack to be successful. In this thesis, the importance of MW was demonstrated through acquisitions, which could indicate a high pace of development in middleware layer. Being highly digital, the operating environment of platform leaders is very dynamic. In this environment, platform leaders can have a hard time predicting and developing internally all the digital technologies they will need in the future. Acquisitions can be used as a means of innovation (Puranam and Srikanth, 2007) and substitute to internal R&D (Bower, 2001), and thus acquisitions could be especially important for developing MW technologies.

This thesis finds multiple levers that can make MW strategic for platform leaders during platform wars. Firstly, building on previous research (Hagiu, 2007; Tan *et al.*, 2015; Koch and Windsperger, 2017), this thesis suggests platform leaders focus on acquiring MW technologies to actively drive their platform development by increasing innovation speed. MW components are re-usable by nature (Schmidt and Buschmann, 2003), and can provide services to support AS layer components. Furthermore, MW components can make AS layer component development easier and allow platform leaders to develop new functionalities to their platform more quickly. As sustained competitive advantage could be achieved by actively shaping competitive environment (Koch and Windsperger, 2017), this increase in innovation speed can provide an edge over competing platforms.

Secondly, this thesis also suggests that MW acquisitions are used to acquire technology that could radically improve the user interactions with the platform. This suggestion emerges from the empirical finding that each case company had acquired user-interface related MW technologies, such as Virtual Reality and Virtual Assistant technology. User-side network effects are critical in most of the key platforms of the case companies, and delivering user experience is done with Application Software. However, AS relies on the MW layer below to deliver the user experience, and thus these MW components are key in improving it. Hence, the increase of middleware acquisitions could be tied to platform leaders' efforts to improve their platforms' interactions.

This thesis also finds evidence that technology acquisitions can have a significant role in the coring and tipping strategies of platform leaders (Gawer and Cusumano, 2008). The findings fit into the notion that platform companies should first focus on developing their platform core, following a coring strategy (Gawer and Cusumano, 2008). In acquisitions, this coring strategy is executed by acquiring companies in the same layers where the acquirers' platform cores are. These targets can provide the acquirer beneficial technologies or talent, but also users if the target has a competing platform. To win platform wars with a tipping strategy or "platform envelopment" (Gawer and Cusumano, 2008; Eisenmann, Parker and Van Alstyne, 2011), companies could use acquisitions in multiple ways. The focus of acquisitions on user-experience-enhancing MW technologies could support platform envelopment: if a platform is able to deliver clearly superior user experience, the benefits gained by users who switch to this platform can overcome the switching costs of using a competing platform. Thus, MW acquisitions can serve a critical part of the tipping strategy of platform leaders. The findings also suggest that platform leaders seek to enable their own technology-driven platform envelopment efforts, while simultaneously protecting from similar efforts by their competitors, by acquiring rare middleware technologies before competitors do. This competitive driver in middleware acquisitions also serves to complement existing acqui-hiring research (Coyle and Polsky, 2013; Sawicki, 2015), suggesting that platform leaders make acqui-hires also to simultaneously both enable and defend from platform envelopment attacks by acquiring rare talent, thus justifying the high costs of such measures. As a lot of scarce talent lies in MW technology companies, this also serves as a lever for making MW strategic.

This thesis does not find evidence for synergistic benefits of technology acquisitions, suggesting that a larger technology base might not encourage platform leaders to make acquisitions that benefit multiple technology areas at once. This relates to the decision whether to grow a platform in breadth, where the platform company "needs to trade off the synergies, economies of scale and/or network effects created by novel search or shared costs reductions against the increasing complexity costs and diseconomies of specialization, which occur when the platform acquires new dimensions" (Hagiu, 2014). While supporting evidence was not found for the hypothesis on synergistic benefits for SS layer, the results are more mixed for the synergy hypothesis for MW layer, and the synergistic benefits might still be a driver of MW acquisitions. However, this might be less likely as multiple drivers for MW acquisitions already arise from the findings and existing research. This could be a reassuring indication for new platform companies, suggesting that they can still rise among the platform leaders even if their technology base is clearly less developed.

These findings should be of interest for both academia and industry. For academia, this thesis further validates the viability of the software stack as a model to analyze technology companies, and provides insights on how platform leaders use acquisitions to fight platform wars. It also advances the conceptual understanding of how software stack can describe the technological foundations of a platform. By describing the acquisition activity of the world's leading platform companies, this thesis supports managers in their effort to create strategies for developing new and existing platforms.

5.1 Alternative explanations

Section 5 Discussion and conclusions above provides an interpretation of the results, aligned with existing research and theories. However, the empirical findings can also have alternative explanations, which are more speculative and emerge from the empirical data rather than the theory base of this thesis. This section goes through these explanations, and explains the rationales behind them. The validity of these alternative explanations need to be addressed in future research to improve the confidence of the implications presented in section 5 Discussion and conclusions above.

Explanation 1 – Middleware Services is the only stack layer that currently has room for significant technological differentiation between platform companies

Software stacks, which cover all digital technologies, have been under development since the early days of computing. Whereas during early days the development focused on Hardware and System Software layer components, the rise of internet shifted the focus towards higher layers of Application Software and Middleware Services. From a technological maturity perspective, it would make sense that the layers that have been in the focus of development are more commoditized, thus making it easy to build or buy technology in the layer without acquisitions.

Modern web applications can be built with software stacks that have little emphasis on own Middleware Services components, as software development frameworks for developing Application Software components are abundant. This has caused commoditization in the Application Software layer, making it harder to achieve competitive advantage with simply distinct Application Software. However, as the high acquisition intensities and continuous emergence of new AS development frameworks demonstrate, many kinds of Middleware Services components are underdeveloped, and thus provide an opportunity for differentiation. Acquisitions serve to speed up this differentiation, as well as to slow down the catching up of competition through locking in scarce, specialized talent.

Explanation 2 – Layers develop in cycles, and Middleware Services layer's development is simply peaking now

History has many examples of digital innovations or inventions that spark a wave of innovation to follow. Semiconductors brought upon a wave of development in System Software layer, including operating systems and databases, and similarly internet has brought upon the need to develop browsers and websites. With the current continuing development of computational power and increased amount of data, development for more data and computationally intensive Middleware Services components has hastened.

It is possible that the increased interest in Middleware Services layer technology would be in part caused by the developments in computational power and data storage, which has increased the amount of technological innovation happening in the layer by enabling more data and computationally intensive software. Consequently, a growing amount of companies working in the field would give rise to more technologies that large platform companies would benefit from. The platform leaders have a rich technology base behind them, making technologies in every layer of the stack relevant for them.

Explanation 3 – Platform competitive advantage is built with distinct technology

Each of the case companies can be considered a technology company and their platforms, like all digital offerings, require technology in all parts of the stack to operate. The implementation on each layer can be done in-house by the company, or they can allow third parties to develop or provide the technology to their software stack. Generally, a fully outsourced stack is easy to imitate as the used technology is available to anyone, and a fully in-house software stack is harder to imitate as far as any third parties don't offer suitable substitutes for the used in-house technologies.

With this dynamic in mind, a platform company might pursue technological differentiation by acquiring or developing unique solutions to stack layers where suitable third party substitutes are scarce or nonexistent. In practice, such differentiation could in part enable superior user experience, developer tools, scalability, or other benefits that keep the platform more attractive than the competing ones. In this scenario, acquiring technology companies can give access to emerging technologies in fields where talent and assets are scarce. Such acquisitions can be seen in the findings, with many acquisitions happening in the fields of Artificial Intelligence, Machine Learning, Augmented or Virtual Reality, and many more.

5.2 Limitations and future research

While previous research has touched upon a multiple of drivers, which also lead to the hypotheses of this research, the results need to be further validated as no statistical tests are performed.

While the stack model is a widely used framework in the IT industry (Gerstner, 2003), it comes with its limitations. The layered model simplifies the technological components into layers, and assumes that all components in a layer are alike. Yet, there are big differences in the functionality as well as complementarity between different pairs of components in one layer (Gao and Iyer, 2006), and the aforementioned assumption does not always hold. Thus, the software stack lacks the granularity to accurately describe the interplay of technological components. This means that a platform's core, for example, is assumed to cover an entire layer, rather than specific components in the layer.

When acquisitions are linked to the layer, it is similarly assumed that they relate to the entire layer rather than the specific components of the platform core in the layer, while these components might be intended to serve as components to different platforms altogether. For example, in the case of Google, their advertising engine forms their MW core layer, but they might buy a Voice recognition company to the MW layer. These acquisitions seem to be highly similar from the stack model perspective – they are in the same layer after all – but perhaps serve as components to two separate offerings like AdWords and a Virtual assistant. Similarly, the generic nature of the stack model leaves multiple explanations for increased acquisitive behavior. For example, the small increase in Apple's SS acquisition amount could be interpreted as a sign of Apple receiving synergistic benefits from having core layers in HW, SS, and MW layers, but also as a focused investment to support its core layer in SS.

M&A data does not reveal technological pivots, e.g. buying in a team and making them work on something that is different from their initial focus, but matches their capabilities. Such cases can lead to misallocation in the stack. Similarly, for some companies there is only little data available about what they do, and this can also cause them to be misallocated in the stack. Sometimes the targets can also have technology in multiple layers of the stack, but as the targets are often small companies, this thesis simplifies their technological focus to just one stack layer.

These issues highlight the challenges of an outside-in view taken in this thesis, and thus there is a need for in-depth single case studies to further validate the insights of this thesis. Furthermore, single-case studies could also better study the internal technological development efforts of platform leaders, and integrate the findings of this thesis to form a perspective on how the development of technology relates to the planned competitive strategy of MSPs.

While the findings of this thesis need to be further validated, they are well aligned between case companies and provide a base of theory for understanding platform leaders' technology acquisitions. However, the method lacks statistical tests, and does not address the degree to which the different explanations account for the observed behavior. Additionally, the benefit of the acquisition activity of platform leaders is not quantified, but rather assumed high enough to make their acquisition strategies good. Further studies could seek to quantitatively understand how big the role of these strategies is for platform companies. While this thesis studies only four platform leaders, there are not many such platform leaders around, and thus the sample of the most formidable technology titans covers a significant portion of all platform leaders. As this thesis already describes the acquisition behavior of some of the most important MSPs, it remains an interesting view on how the most successful MSPs make acquisitions. Regardless, a larger sample could further validate the implications of this thesis, and include MSPs that have not been as successful to understand what kind of acquisition behavior could predict worse performance.

It is important to note that while this thesis provides insights on the acquisition strategies that current platform leaders use, acquisitions are only one part of the strategies that made these companies platform leaders. Furthermore, while this thesis describes the acquisition strategies of platform leaders during the ongoing platform wars, it remains to be seen which companies come out of the war as winners.

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Appendix

Table 18 Number of Google's yearly acquisitions by stack layer

	‘03	**‘04**	**‘05**	**‘06**	**‘07**	**‘08**	**‘09**	**‘10**	**‘11**	**‘12**	**‘13**	**‘14**	**‘15**	**‘16**	**‘17***	**Total**
AS	1	1	1	3	2	2	0	3	9	3	0	4	1	2	0	32
MW	1	1	0	5	4	2	2	18	11	5	9	17	7	8	6	96
SS	1	0	1	0	3	0	0	5	0	1	2	5	1	1	0	20
HW	0	0	0	0	1	0	0	1	0	2	1	1	0	0	0	6
Total	3	2	2	8	10	4	2	27	20	11	12	27	9	11	6	154

*Year to 10/2017

Table 19 Number of Apple's yearly acquisitions by stack layer

	‘97	**‘98**	**‘99**	**‘00**	**‘01**	**‘02**	**‘03**	**‘04**	**‘05**	**‘06**	**‘07**	**‘08**	**‘09**	**‘10**	**‘11**	**‘12**	**‘13**	**‘14**	**‘15**	**‘16**	**‘17***	**Total**
AS	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	2	0	5
MW	0	0	0	0	1	2	0	0	0	2	0	0	2	4	0	1	6	5	8	3	4	38
SS	0	0	0	0	1	1	0	0	1	0	0	0	0	0	0	2	4	1	1	1	0	12
HW	1	0	1	0	0	1	0	0	0	0	0	1	0	1	0	1	1	2	1	0	1	11
Total	1	0	1	1	2	4	0	0	1	2	0	1	2	5	0	4	12	9	10	6	5	66

* Year to 10/2017

Table 20 Number of Facebook's yearly acquisitions by stack layer

	‘07	**‘08**	**‘09**	**‘10**	**‘11**	**‘12**	**‘13**	**‘14**	**‘15**	**‘16**	**‘17***	**Total**
AS	0	0	0	6	7	5	4	3	1	1	1	28
MW	1	0	0	3	2	2	2	5	2	5	2	24
SS	0	0	0	0	0	0	0	1	0	1	0	2
HW	0	0	0	0	0	0	0	0	0	1	0	1
Total	1	0	0	9	9	7	6	9	3	8	3	55

*Year to 10/2017

Table 21 Number of Amazon's yearly acquisitions by stack layer

	‘98	**‘99**	**‘00**	**‘01**	**‘02**	**‘03**	**‘04**	**‘05**	**‘06**	**‘07**	**‘08**	**‘09**	**‘10**	**‘11**	**‘12**	**‘13**	**‘14**	**‘15**	**‘16**	**‘17***	**Total**
AS	1	0	0	0	0	0	1	1	0	1	5	2	3	4	2	3	3	0	0	2	28
MW	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2	1	4	2	5	16
SS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	3
HW	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	2
Total	1	0	0	0	0	0	1	1	0	1	5	2	4	6	2	6	5	5	3	7	49

*Year to 10/2017